SAND FILTER VAULT SIZING WORKSHEET
2005 Surface Water Design Manual Sizing Method

Name:

METHODS OF ANALYSIS (Section 6.5.2.1), Simple Sizing Method

Step 1) Determine whether a basic or large sand filter is needed.

See Core Requirement 8 (1.2.8) and the WQ applications map in the back of the design manual.

* Large sand filter -- an option in resource stream or sensitive lake areas, or partial option for sphagnum bog areas

* Basic sand filter -- an option for basic WQ treatment areas or part of a 2-3 facility treatment train for other areas

Basic, regionally significant resource stream, sensitive lake, or sphagnum bog area?	Basic	Water Quality Applications Map, manual back cover
Basic or Large Sand Filter?	Basic	Consult water quality menus in Section 6.1

Step 2) Determine rainfall region and regional scale factor.

Refer to the precipitation scaling map in Chapter 3, Figure 3.2.2.A.

Rainfall Region: Landsburg or Seatac?		(unitless)	Required Figure 3.2.2.A
Regional Scale Factor:		(unitless)	Required Figure 3.2.2.A

Step 3) Determine maximum depth of water above sand filter

Select maximum water storage depth above the surface of the filter depending on site topography.

d= maximum water depth above sand		(ft)	Select now; maximum 6 feet (6.5.2.2)

Step 4) Determine site characteristics

For the simple sizing method, vegetated areas other than grass may be represented as grass.

Soil Type: Till or Outwash?				See Table 3.2.2B
T_i=	tributary area of impervious surface		(acres)	Roads, roofs, etc, See Table 3.2.2.1
T_{tg}=	tributary area of till grass		(acres)	Landscaping and forest, See Table 3.2.2.1
T_{og}=	tributary area of outwash grass		(acres)	Refer to Table 3.2.2.1

Step 5) Calculate minimum required surface area for sand filter

$A_{sf} = 0.7\ C_s(T_iA_i+T_{tg}A_{tg}+T_{og}A_{og})$

0.7=	adjustment factor for routing effec	0.7	(unitless)	
C_s=	regional scale factor		(unitless)	From Step 2
T_i=	tributary area of impervious		(acres)	From Step 4
T_{tg}=	tributary area of till grass		(acres)	From Step 4
T_{og}=	tributary area of outwash grass		(acres)	From Step 4
A_i=	filter area for impervious		(sf/acre)	Table 6.5.2.A, Ai Impervious column "d"
A_{tg}=	filter area for till grass		(sf/acre)	Table 6.5.2.A, Atg Till grass column "d"
A_{og}=	filter area for outwash grass		(sf/acre)	Table 6.5.2.A, Outwash grass column "d"
A_{sf}=	sand filter area		(sf)	

Step 6) Size the underdrain system

*Design criteria in "underdrain systems"(6.5.2.2) can be used or do capacity analysis for feeder pipes.

* The pipe collecting flows from the underdrain system shall be sized to convey the 2-yr 15-min. peak flow with one foot of head above the invert of the upstream end of the collector pipe. Capacity can be checked using the "KCBW" standard step back water program.

KCRTS developed, 2-year return period, 15-minute time step, peak flow		(cfs)	See Section 3.2.2

Rainfall region: Seatac or Landsburg?			See Step 2 or Figure 3.2.2.A
Scale Factor:		(unitless)	See Step 2 or Figure 3.2.2.A
Time Step: hourly or 15-min?			Required "15 min"
Data Type: Reduced or historic?			"Reduced," (3.2.2.1)
Till grass		(acres)	See Step 4 "T_{tg}"
Outwash grass		(acres)	See Step 4 "T_{og}"
Impervious		(acres)	See Step 4 "T_i"
Effective area			(3.2.2.1)

Step 7) Determine presettling volume

Determine rainfall *R* for mean annual storm.

Rainfall (R) _____ (feet) Required from Figure 6.4.1.A

Calculate runoff from mean annual storm

$V_r = (0.9A_i + 0.25A_{tg} + 0.10A_{tf+} 0.01\ A_{og}) \times R$

A_i=	tributary area of impervious surface	_____	(sf)
A_{tg}=	tributary area of till grass	_____	(sf)
Atf =	tributary area of till forest	_____	(sf)
A_{og}=	tributary area of outwash grass	_____	(sf)
R =	rainfall from mean annual storm	_____	(ft)
V_r =	volume of runoff from mean annual storm	_____	(cf)

Calculate presettling volume

$V_b = f\ V_r$

f =	Volume factor	0.75	(unitless)
V_r =	volume of runoff, mean annual storm		(cf)
V_b =	Volume of the wetpool		(cf)

Calculate presettling cell size

Vault depth	_____	(ft)	
Vault area	_____	(sf)	Volume /cell depth
Vault width	_____	(ft)	Use 20' w for precast options
Vault length	_____	(ft)	

Size Summary: Surface area change in elevation

Total surface area equals sand bed area, surface area of presettling cell plus addtl for inlet/outlet pipes

Sand surface area	_____	(sf)	
Presettling surface area	_____	(sf)	
Outlet pipe area		(sf)	(3'X20')
Total surface area		(sf)	

The elevational change needed includes

sand depth	_____	(ft)	(required)
underdrain	_____	(ft)	(minimum)
Depth "d" above sand	_____	(ft)	(Depends on design)
Total fall needed:	_____	(ft)	

Other design criteria (Section 6.5.2.2)

Pretreatment, Flow Spreading, Energy Dissipation

Overflow and bypass structures

Filter Composition and specifications

Access to inlet, outlet, over sand bed